

Land Cover Trends

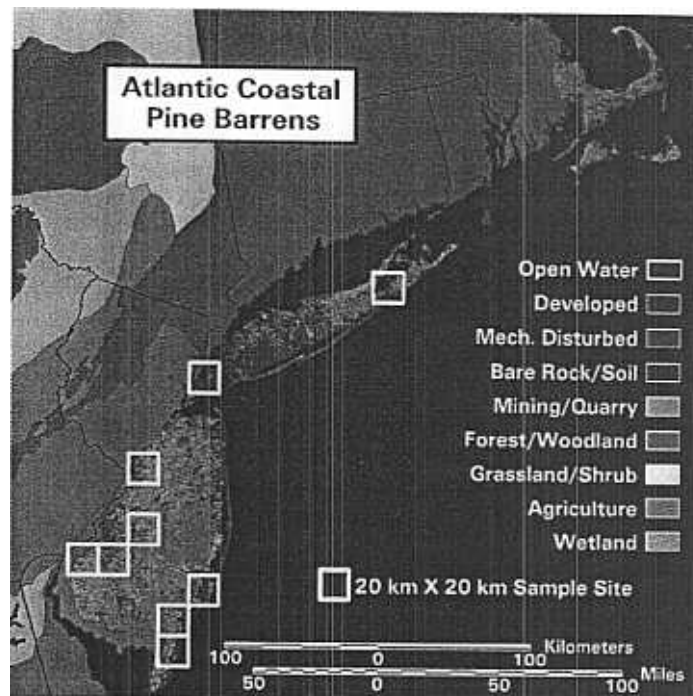
Atlantic Coastal Pine Barrens

Ecoregion Description

The Atlantic Coastal Pine Barrens is a disjunct ecoregion covering approximately 6,200 square miles of the coastal plain of New Jersey, Long Island in New York, and Cape Cod, Martha's Vineyard, and Nantucket in Massachusetts, as well as nearby islands. Hydrology, soils, fire regimes, and vegetation combine to distinguish this ecoregion from neighboring ecoregions. The region has a wide variety of ecological systems, including cedar swamps, meadows, stunted pitch pine and oak forests, sphagnum bogs, heathlands, coastal salt ponds, dune systems, and the Nation's only maritime grasslands on Martha's Vineyard and Long Island.

Rainfall averages about 48 inches per year, but the soil is sandy, extremely porous, and drains very quickly. Soils and water in the ecoregion are generally very acidic, which limits naturally occurring flora, fauna, and suitable agricultural crops. Acid-tolerant shrubs, such as those of the heath family (blueberries, laurels, staggerbush), are common. Agricultural activity in many areas is limited to acid-loving crops, such as blueberries and cranberries, although parts of the ecoregion with richer soils support fruits, vegetables, and other crops. Aquatic fauna must also be acid-tolerant, resulting in relatively few species of freshwater fish and amphibians.

Historically, fire is the major disturbance factor influencing vegetation composition in the ecoregion. In its natural state, the landscape is swept by frequent fires, giving the advantage to species able to cope, such as pitch pine, scrub oak, heath shrubs, and bracken fern.



The Atlantic Coastal Pine Barrens. The areas in color represent land cover types for the Atlantic Coastal Pine Barrens ecoregion. The nine 20- by 20-km sample sites for the Land Cover Trends project are shown in yellow.

Parts of the ecoregion represent some of the best preserved habitat in the Eastern United States, but others are among the most highly developed lands in the country. The western half of Long Island, as well as much of the Jersey Shore and Cape Cod, is very densely populated and developed.

USGS Land Cover Trends Project

The Land Cover Trends project is a joint effort between the U.S. Geological Survey, the U.S. Environmental Protection Agency, and NASA to study contemporary land cover change in the conterminous United States. Eighty-four ecoregions, areas containing a geographically distinct assemblage of environmental conditions, natural communities, and species, serve as separate reporting units. A sampling approach using randomly selected sample blocks is used to estimate land cover change in each ecoregion. Historical Landsat multi-spectral scanner (MSS) and thematic mapper (TM) satellite images, along with historical aerial photographs, are used to derive land cover maps for five separate dates (1973, 1980, 1986, 1992, and 2000). The sample block land cover data are used to analyze the spatial, temporal, and sectoral dimensions of change. A full discussion of project methodology can be found in Loveland et al. (2002).

Historical Land Use and Land Cover

Early land use and land cover change was based largely on natural resource extraction, especially on the use of vast timber resources. Rot-resistant white cedar was in high demand for shingling, ship building, and other uses. Pitch pine provided a source of strong, dense, high-quality wood for flooring, furniture, construction, and fuel, and the pine's resin was widely used for naval stores. The enormous demand for wood, coupled with uncontrollable forest fires, drastically changed the landscape of the region from its prehistoric form (Berger and Sinton, 1985, 117).

Early in the 19th century, a booming iron industry began. The New Jersey Pine Barrens were rich with "bog iron," natural deposits of iron-rich material. Clam and oyster shells from the shoreline were harvested to provide lime required for smelting, and the vast forestlands provided the fuel. However, the production of bog iron ended by the 1860s, because higher grade iron and coal deposits discovered in Pennsylvania and elsewhere were much more efficient to exploit.

Glass industries also took advantage of the natural resources of the Pine Barrens. The quality of the sands, the abundance of trees for fuel, and the proximity of large urban markets made much of the area ideal for the production of glass products. Twenty glass industries were established by 1800 in the New Jersey Pine Barrens alone, but all had closed by 1870.

Beginning in the 1850s, railroads brought newcomers into the area. The railroads encouraged truck farming, fruit farming, and tourism by linking the region with nearby urban centers. Berry agriculture soon replaced rural industry in parts of the ecoregion. The acid-loving cranberry became a primary crop, given its ability to grow in the poor, acidic soils found throughout much of the ecoregion. A commercially profitable domestic blueberry crop was developed by 1916, yet another acid-loving crop extremely well suited to the region. Other areas of the ecoregion with richer soils, such as Long Island and the part of New Jersey closer to the Delaware River, became agricultural hinterlands to New York City and Philadelphia. Long Island became known for the large quantity of potatoes grown there.



Cranberry bog. A cranberry bog in rural New Jersey, ready for harvesting. Cranberries and blueberries, two acid-loving crops, thrive in the Atlantic Coastal Pine Barrens.

Developed land uses started to expand during the late 19th and early 20th centuries. Resort communities became established on many of the barrier islands along the New Jersey shore, including Atlantic City. The commercial activities associated with seasonal resorts quickly became the backbone of the economy along the New Jersey Shore, Cape Cod, Martha's Vineyard, and eastern Long Island.

Urban development became a substantial land use change in parts of the ecoregion during the 20th century, especially in the post-World War II automobile-dominated suburbs of the nearby large cities. The western and central sections of Long Island became extensive suburbs of New York City, with Nassau and Suffolk Counties each having more than a million residents by 1970. The greater New York City/northern New Jersey metropolitan area was also encroaching from the north into central New Jersey. The Philadelphia metropolitan area grew into the ecoregion from the west as the New Jersey suburbs expanded. Development in the coastal areas continued as more seasonal and second homes were built along the Jersey shore, Cape Cod, Martha's Vineyard, and the Hamptons of eastern Long Island.

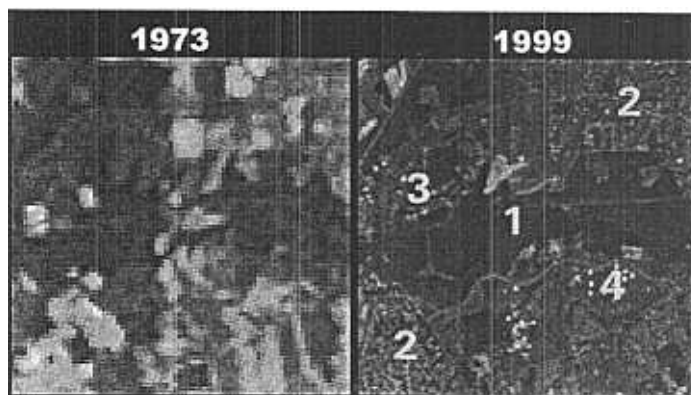
Contemporary Land Use and Land Cover Change

The USGS Land Cover Trends project analyzed land use and land cover change in the Atlantic Coastal Pine Barrens

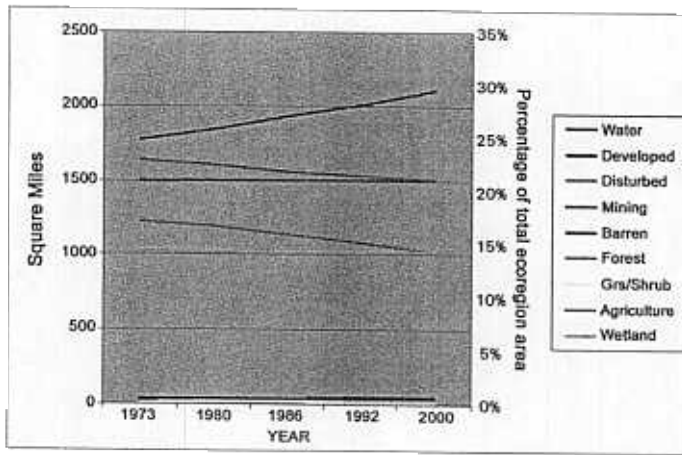
ecoregion using a sampling framework and historical satellite imagery. The overall rates of land cover conversion were generally steady, hovering around 1.5 percent total change per time interval. Of the total landscape, 5.3 percent changed land use/cover types once during the 1973 to 2000 study period, while 0.4 percent changed more than once.

	'73 to '80	'80 to '86	'86 to '92	'92 to '00
Total Change	1.5%	1.7%	1.4%	1.5%
Interval	Sq. Miles	Transition Type		
1973 to 1980	34	Forest to Urban		
	29	Agriculture to Urban		
	8	Mechanically Disturbed to Urban		
1980 to 1986	51	Agriculture to Urban		
	37	Forest to Urban		
	7	Forest to Mining		
1986 to 1992	46	Agriculture to Urban		
	22	Forest to Urban		
	5	Mechanically Disturbed to Urban		
1992 to 2000	64	Agriculture to Urban		
	22	Forest to Urban		
	5	Mechanically Disturbed to Urban		

Although overall change rates are relatively low, significant land cover trends are apparent. The table above shows the three most common land cover transitions by time interval, listed in descending order. Note that "Mechanically Disturbed" represents lands that have been altered by human activity, such as the cutting of forestlands for timber. The general trends show gradually increasing developed (urban) land cover, with parallel reductions in the amount of forest and agricultural land. Other forms of land cover conversion were generally minor. Although the total percentage of area changed may seem relatively low, the vast majority of that change was the transformation of other land cover types to urban/developed uses. More than 325 square miles of land was developed from 1973 to 2000, resulting in the loss of 190 square miles of agricultural land, 115 square miles of forest, and 20 square miles of other land cover types.



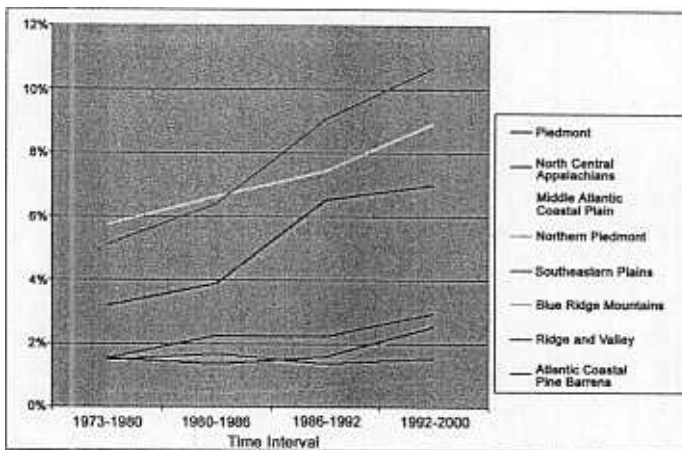
Multidate satellite imagery, showing some of the typical changes found in the ecoregion. The image on the left is Landsat multispectral scanner data from 1973, and the image on the right is Landsat enhanced thematic mapper plus data from 1999. Changes in this time span include (1) a new reservoir, (2) new residential developments, mostly at the expense of agricultural land, (3) a new golf course, supporting the high recreational demands in the ecoregion, and (4) ball fields and a park complex.



Contemporary Trends: Urban land area increased by more than 325 square miles from 1973 to 2000, primarily at the expense of agricultural land and forests. Other mapped land cover types in the ecoregion showed relatively little change.

Connections with Neighboring Ecoregions

The Atlantic Coastal Pine Barrens has undergone considerably less change, as a percentage of total area, than many of the Eastern United States ecoregions. Overall change was about 1.5 percent for each of the four time intervals, but some eastern ecoregions experienced change as high as 11 percent for a single interval. This can be explained by the relative lack of timber harvesting in the Pine Barrens compared to ecoregions such as the Southeastern Plains and the Middle Atlantic Coastal Plain. Where a thriving timber industry is present, the area represented by clearcuts is generally much higher than that undergoing conversion to developed uses.



Ecoregion Comparison: The Atlantic Coastal Pine Barrens (in red) exhibits less total change per interval than most other Eastern United States ecoregions.



New homes along the Jersey Shore.

The Atlantic Coastal Pine Barrens lacks a large-scale timber industry, but it is one of the most dynamic eastern ecoregions in terms of increasing urban development. Nearly 4.5 percent of the ecoregion area was converted to developed uses from 1973 to 2000. A similar

increase in developed land cover is found in the adjacent Northern Piedmont ecoregion. Combined, these two ecoregions cover much of the Northeastern United States "megapolis,"

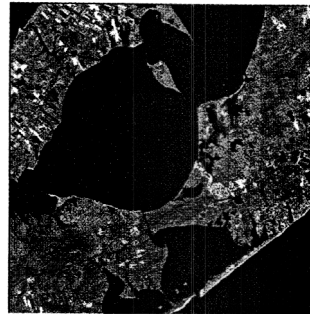
the heavily developed urban corridor running from Washington, D.C., in the south, through Baltimore, Philadelphia, and New York City, to Boston in the north.

	Population	Persons per sq. Mile
1970	9,585,784	1,574
1980	9,599,396	1,576
1990	10,081,769	1,656
2000	11,017,900	1,810

Population Growth: Both overall population and population densities have substantially increased since 1970.

Drivers of Contemporary Land Use Change

Between 1970 and 2000, population in the ecoregion increased 15 percent, from 9.6 to 11.0 million. Locally, population increases have been more dramatic, with Cape Cod experiencing a doubling in population over the same time period (from roughly 100,000 to more than 220,000). Accommodating this growth was the primary driver of landscape change.



Loss of agricultural land on a part of Long Island. Red areas depict agricultural land lost to urbanization since 1973, while yellow areas depict losses of other land cover types.

One response to the increases in population was a 25-percent decrease in farmland since 1970. Some farmers sold their land for development (Hart, 1991), while others switched from vegetables to higher valued nursery stock, flowers, or sod. Environmental protection efforts have effectively slowed or stopped urban growth in many environmentally sensitive areas, however (Walker and Solecki, 1999). For example, New Jersey and the Federal

Government have cooperated to protect the New Jersey Pine Barrens. The Pinelands were designated as the Nation's first Biosphere Reserve and are part of the U.S. Man in the Biosphere Program (Mason, 1992; Walker and Solecki, 1999).

Nonetheless, urban pressures continue to exert a powerful force. The region's population continues to grow, and many residents desire a less crowded lifestyle than previous generations. Much of the growth occurs at or near major highway intersections and in high-amenity coastal zones. Recently, retirement communities have become a substantial land use development trend. Increased populations, especially those of retired persons with large amounts of free time, have also resulted in an increased demand for recreational facilities, such as golf courses and public beaches.



Recreational uses, such as golf courses, vacation homes, and localized gambling, are economically and socially important in parts of the ecoregion.

Increased urbanization in the ecoregion has also resulted in aggressive fire suppression, changing the composition of many of the ecoregion's plant communities. With prolonged fire

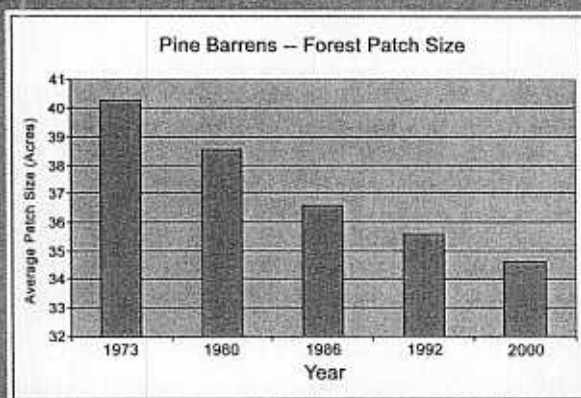
suppression, vegetational succession leads to the replacement of pine barrens by oak forest. In addition, fire fuel build-up leads to very intense fires that kill all vegetation, including the naturally fire-resistant pitch pines. The impacts of increased land management can thus change land cover composition in areas remote from actual development.

Consequences of Change

Some of the important implications of change and resultant concerns in the Atlantic Coastal Pine Barrens are as follows:

1. Loss of Agricultural Land - Loss of agricultural land, forest, and other land to urban uses has been the primary form of land cover change. Loss of agricultural land in Long Island and Cape Cod has led the American Farmland Trust organization to name the area as one of the 20 most threatened agricultural areas in the country. While the rate of urbanization has remained roughly the same throughout the 1973 to 2000 period, the development of agricultural land has sharply increased. As a result, Agricultural Protection Areas have been designated where existing agricultural activities are important or where favorable soils for such activities exist. The continuance of agricultural activities in these areas is strongly encouraged by prohibiting urban development.

2. Ecosystem Fragmentation - The Pine Barrens are naturally fragmented, with local habitats heavily dependent on the substrate. However, road networks, forest clearing, urban expansion, and other activities have further fragmented parts of the Pine Barrens. Habitat patch size is an important factor for many animal species, with a general correlation between increasing patch size and increasing habitat suitability. Several species of butterflies and moths (Karner Blue Butterfly, Frosted Elfin, Barrens Buckmoth), for example, depend on pitch pine/scrub oak habitats, some of which require a thousand or more contiguous acres to have enough larval food plants to support a breeding population.



The size of forest patches in the Pine Barrens has steadily decreased from 1973 to 2000. Habitat fragmentation can have detrimental effects on many animal and plant species.

3. Ground-Water Issues - Population growth in the ecoregion has put increased pressure on water resources. Water resources are threatened by local water quality issues (septic system density and leakage, agricultural chemicals, petroleum product spills, and so on), as well as by regional problems such as pollution from the EPA Superfund site at the

Massachusetts Military Reservation on Cape Cod. The highly permeable, sandy soils found throughout much of the ecoregion result in very little runoff and rapid percolation into ground-water resources and thus increase the probability of ground-water contamination from surface pollution sources. Overpumping of ground-water resources is also an issue. Even modest reductions in the water table elevation can have severe negative effects on the sensitive wetlands in the ecoregion (SCDHS, 1987).

Future Trends

Given the continued pressures of expansion from neighboring urban centers, the demand for recreational opportunities in the ecoregion, and the growth of retirement communities, it is expected that urban development will continue to be the primary land use conversion for the foreseeable future. Although the development of forestland outstripped the development of agricultural land during the early part of this study, the development of agricultural land became the increasingly dominant form of urbanization through each time interval. With increased environmental awareness and the desire to protect natural habitats, it is expected that development pressures will result in the continued loss of agricultural land, with somewhat less but still significant pressure on the Pine Barrens.

Land Cover Trends and The National Map

Land cover and land use change information provided by the Land Cover Trends project makes up an important component of *The National Map*. *The National Map* is a consistent framework for geographic knowledge needed by the Nation. It provides public access to high-quality geospatial data and information from multiple partners to help inform decision-making by resource managers and the public. *The National Map* enhances America's ability to access, integrate, and apply geospatial data at global, national, and local scales. Web site: www.nationalmap.usgs.gov

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